Winter 2013

Research Newsletter

Responsive - Accessible - Relevant

A MESSAGE FROM THE RESEARCH DIRECTOR

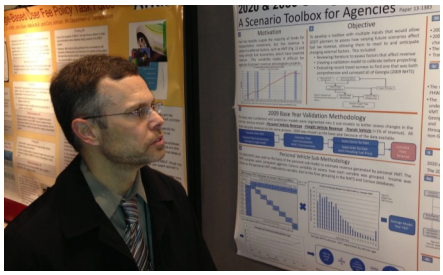
By: Cameron Kergaye, PhD, PMP, PE

On behalf of the Research Division, I look forward to many new events this year starting with the largest gathering of transportation and research professionals in the US – the Transportation Research Board annual meeting this week (mid-Jan) in Washington D.C. This meeting will be attended by a number of UDOT engineers, each of whom is responsible to bring back innovations and technological improvements to Utah. Last year's eight attendees from UDOT returned with over 20 innovations to implement such as internal curing of concrete bridge decks, complex project management strategies, incorporating economic development in prioritizing projects, and real-time traffic signal performance measurement.

Many of the anticipated TRB presentations will focus on SHRP2, which is a sequel to the first Strategic Highway Research Program. After several years in development, this national transportation research program is delivering beneficial products in terms of renewal, capacity, reliability and safety improvements. This year SHRP2 is expected to offer a significant number of implementation opportunities for DOTs.

The highway research arm of TRB has just sent out its initial ballots for selecting FY14 research. UDOT is currently reviewing 122 new problem statements, six of which were developed in cooperation with UDOT professionals and local university researchers. New problem statements will also be solicited this year for FY15 program funding.

Lastly, UDOT's Research Division is planning to host another Research Workshop (UTRAC) this spring. This is an opportunity to determine problems and solutions to Utah's transportation system. In addition to UDOT's core subject areas, the 2013 workshop will also facilitate an innovative construction session. More details on the workshop date and subject areas, along with a solicitation for problem statements, will be available at the end of January.



In This Issue: (click on desired article, click on logo at top to return to this page)

Completed and Active Research Available at: www.udot.utah.gov/go/research

Editorial Staff: Steve Bagley sbagley@utah.gov and David Stevens davidstevens@utah.gov

By: Kyle Rollins, PhD
Brigham Young University
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UDOT Geotechnical Section

CPT Evaluation of Liquefaction Mitigation with Stone Columns in Layered Silts & Sands

Bridge foundations in seismically active regions of Utah must be capable of dealing with liquefaction and lateral spread displacements. Vibratory stone column treatment is often specified to compact loose, liquefiable sands and silts, but evaluation of improvement typically requires continuous standard penetration testing (SPT) and subsequent laboratory testing. This is expensive and time consuming. The cone penetration test (CPT) provides the potential for more rapid and economical assessment but had not been used in previous UDOT projects.

The goal of this study was to investigate the ability of the CPT to identify fine-grained layers not susceptible to liquefaction, and layers which could not be improved by additional stone column treatment. Typically a soil behavior type index, $I_c > 2.6$ from the CPT has been used to exclude non-liquefiable cohesive layers; however, contractor experience suggests that little improvement can be obtained when the index is greater than about 2.1. In this study CPT results before and after stone column treatment at the Hinckley Drive overpass (SR-79) near Roy, Utah were used to evaluate the CPT-based specifications.

A typical plot of CPT tip resistance, q_{c1n-cs} and I_c versus depth is shown in Fig. 1. Generally, the minimum q_{c1n-cs} value of 11.5 MPa (120 tons per sq. ft) was achieved after treatment when I_c was less than 2.6. As I_c increased, the q_{c1n-cs} values decreased. Tests showed that an $I_c > 2.6$ typically indicated 100% fines content and a soil classifying as silt or clay. To minimize the influence of thin, interbedded clay layers, running average values of q_{c1n-cs} and I_c were obtained over a 0.60-m (2-ft) interval. This procedure eliminated layers which were unlikely to be improved with additional vibration.

Plots of the average q_{c1n-cs} vs. I_c values before and after stone column treatment are provided in Fig. 2. These show little improvement for $I_c > 2.2$.

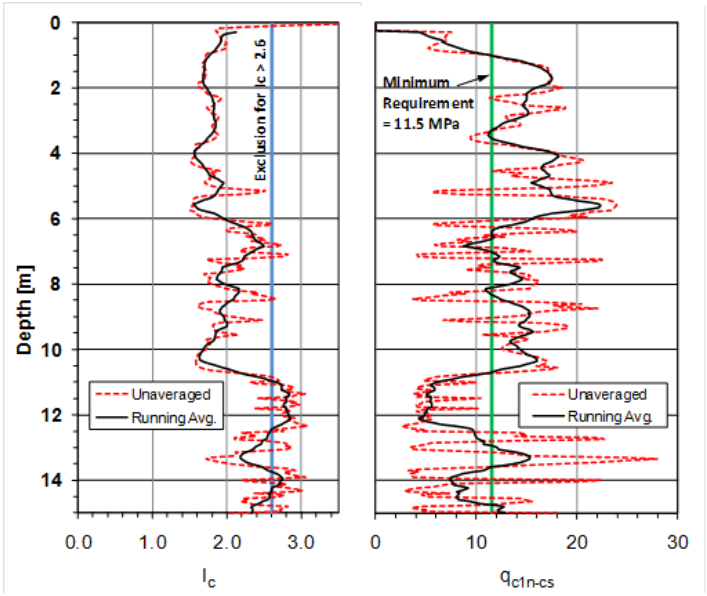

Figure 1: Profile showing q_{c1n-cs} and I_c values versus depth relative to the required values.

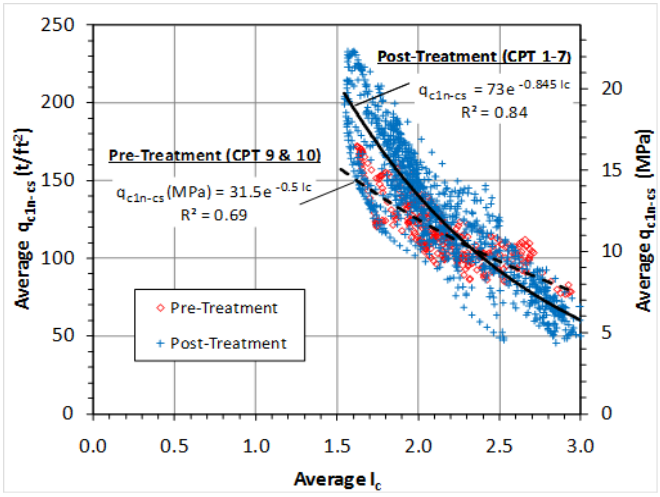

Figure 2: Average q_{c1n-cs} vs. I_c before and after stone column treatment.

Additional results from the study are available in the research report. For more information, contact Kyle Rollins at rollinsk@byu.edu, Darin Sjoblom at dsjoblom@utah.gov, or research project manager David Stevens at davidstevens@utah.gov.

By: Catherine Higgins
UDOT Communication Specialist

Winter Severity Index

Managing resources during winter months in a state that experiences extreme to mild weather conditions can be challenging. Researchers working with UDOT are investigating a method to define the severity of storms and seasons by assigning a numerical value that represents storm characteristics like intensity and duration. The winter severity index will help the UDOT Maintenance Division evaluate the allocation of resources, including staff, de-icing chemicals and equipment.

Research is taking place in two phases. The first phase, which has been completed, was a thorough review of existing research findings for rating systems used in other states. The second phase will start soon and will develop a model specific to Utah. Before being put into full operation, field testing will confirm reliability.

A number of others states in the Midwest and provinces in Canada have developed weather severity indices. While examining how those indices were developed is useful, those models consider region-specific terrain and weather patterns. For example, some states have indices that take freezing rain into account; freezing rain is common in other parts of the country but rare in Utah.

Terrain plays a significant role in Utah's climate, according to Jeff Williams, UDOT Weather Program Manager. The mountain range that extends from Logan to St. George is a "spine" that divides Utah and acts as a climate barrier. Precipitation patterns differ widely from the east to the west side of the mountain range.

"During the winter months, storms often track into Utah from the west," explains Williams. "When these storms interact with Utah's mountains, air rises and results in increased precipitation and heightened road weather impacts. To the east of the mountains, air sinks and dries leading to the driest months of the year for areas such as Vernal and Moab."

"During the summer months, the Monsoon is the dominating weather pattern which allows warm and moist air to flow northwestward from the Gulf of Mexico. Areas east of the mountains receive most of the year's precipitation during the mid to late summer months while areas west of the mountains often stay dry. Flooding is a common concern for areas east of the mountains."

A Utah-specific weather severity index will help normalize the difference between locations and weather events. By comparing resource use from location to location, operations and maintenance managers will be able to improve the efficiency of snow fighting efforts.

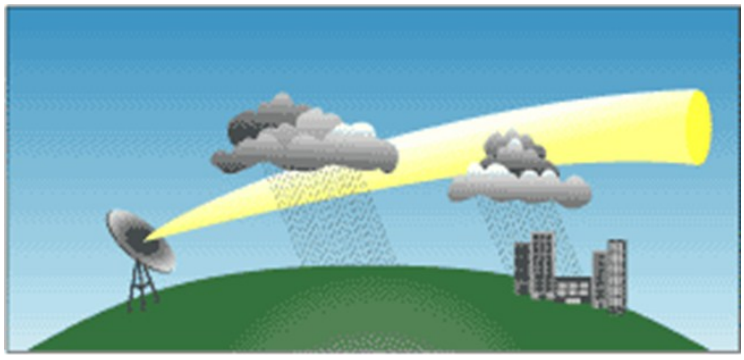

Figure 1: Earth surface curvature effect on radar signal (image courtesy of the Australian Bureau of Meteorology)

Results from Phase 1 of the study are available in the research report. For more information contact Catherine Higgins at CHiggins@utah.gov or research Project Manager Russ Scovil at rgscovil@utah.gov

By: David Stevens, P.E.
UDOT Research Division

SHRP 2 Implementation: Adding Useful Tools To The Transportation Toolbox

On October 10, 2012, Mr. Neil Pedersen visited the UDOT central office and met with several UDOT leaders and managers regarding TRB's second Strategic Highway Research Program (SHRP 2). Mr. Pedersen is the SHRP 2 Deputy Director for Implementation and Communication and has been meeting with various state DOTs to help them prepare for implementation of results from SHRP 2 projects. UDOT leaders benefitted by learning from Mr. Pedersen, and others via teleconference, about SHRP 2 products which will first be available for implementation by state DOTs. Note that "products" is used in this case to mean implementable tools or processes resulting from the research.

SHRP 2 products are centered on four research focus areas: 1) Safety and Driver Behavior, 2) Rapid Renewal of Highway Infrastructure, 3) Reliability of Travel Times and Reduced Congestion, and 4) Capacity and Decision Making. SHRP 2 is administered by TRB under a Memorandum of Understanding with FHWA and AASHTO. Additional background information on SHRP 2 and status of the various projects are available on the SHRP 2 website. SHRP 2 publications are also available on the website, and some of the most useful of these are the Product Fact Sheets. These sheets provide a quick description of the research products most ready to implement, categorized by functional areas common to state DOTs.

Mr. Pedersen shared with UDOT leaders that, in the current three-year SHRP 2 implementation plan, about seven new products will be rolled out each year to state DOTs. He encouraged UDOT leaders to review the available SHRP 2 products and decide which they are most interested in implementing in the near future to improve the way UDOT operates and serves the public. Some SHRP 2 products relate to processes already implemented in UDOT, such as accelerated bridge construction, and on these initiatives UDOT continues to be a resource to other states.

During the October meetings with Mr. Pedersen, and since, UDOT leaders identified a few SHRP 2 products which they would like to implement in UDOT as a lead state. Some of these relate to better travel-time reliability, safer incident recovery, improved project management and risk management, economic impact analysis for projects, and considering freight transport in capacity planning.

We can look forward to learning more about UDOT's involvement in the SHRP 2 implementation process during the coming year. Email subscription to the latest SHRP 2 News is available at the program website.

Additional SHRP 2 information can be obtained by contacting David Stevens at davidstevens@utah.gov.

By: Steve Bagley, M.P.C.
UDOT Research Division

Innovation And Research Poster Session 2012

At this year's UDOT Annual Conference and for the second time, the UDOT Research Division featured an "Innovation and Research Poster Session." This session was held on October 30, 2012 outside the main hall of the South Towne Exposition Center in Sandy.

Figure 1: 2012 UDOT Innovation and Research Poster Session

University professors, students, consultants and UDOT personnel presented twenty-two posters on transportation challenges and solutions in an informal setting. Innovations and improvements to current practices were discussed in a one-on-one setting, and presenters stood beside their posters to explain and/or answer questions about the research.

The Innovation and Research Poster Session was a valuable opportunity to share research, meet creative minds, and discover new approaches to transportation practices. The poster session was well received, brought researchers and others together and was a positive step towards achieving the interactions needed to ensure a robust system for transportation research in Utah.

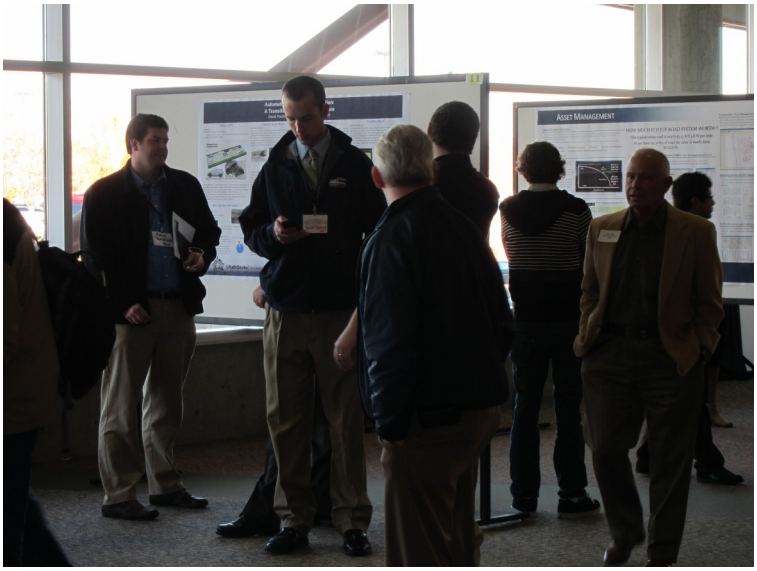

Figure 2: 2012 UDOT Innovation and Research Poster Session

On behalf of the UDOT Research Division, we extend our thanks to all who participated in the 2012 Innovation and Research Poster Session. We would like to thank all the individuals who gave us suggestions of how to improve the overall Poster Session experience and we will implement many of the feasible ideas into the next year.

It is our hope that the Innovation and Research Poster Session serves to illustrate the magnitude and diversity of research being carried out at our institutions and we look forward to hosting it again in the future.

For more information contact Steve Bagley, M.P.C., of the UDOT Research Division at sbagley@utah.gov.

Calendar of Events

UDOT RESEARCH WORKSHOP 2013

As reiterated in the "Message From The Director," UDOT's Research Division is planning to host another Research Workshop (UTRAC) this spring. This is an opportunity to determine problems and solutions to Utah's transportation system. In addition to UDOT's core subject areas, the 2013 workshop will also facilitate an innovative construction session. More details on the workshop date and subject areas, along with a solicitation for problem statements, will be available at the end of January.

RESEARCH FUNDING OPPORTUNITIES (click to see the full document)

January 31, 2013 - Highways for LIFE FY 2013 Discretionary Grant Applications **DUE**

February 15, 2013 - NCHRP Synthesis of Practice Topics **DUE**

March 1, 2013 - NCHRP Highway Innovations Deserving Exploratory Analysis (IDEA) Proposals **DUE**

April 15, 2013 - NCHRP Project 20-7 Spring Submission Cycle Proposals **DUE**